The Millennium Cohort Study: VA and DoD Long-term Collaboration

Prepared for FHP&R VSO-MSO Series – Round table

18 February 2009

Deployment Health and Readiness

Medical Modeling and Simulation

- Personnel
- Equipment
- Supplies
- Resupply
- Footprint

- Epidemiology (service and operational)
- Behavior modification
- Stress/reintegration/family
- HIV/AIDS (DHAPP and PEPFAR)
- DoD Birth and Infant Birth Registry
- DoD Center for Deployment Health Research

Warfighter Performance and Optimization

- Rehabilitation
- Injury prevention
- Environmental performance
- Man/machine/equipment interface
- Stress reactivity

Respiratory Disease Research

Deployment Epidemiological Research

MILLENNIUM COHORT STUDY

Lessons learned from 1991 Gulf War

NAVY TIMES
CAPTAINS
ADMIRAL'S SHUFFLE: WHO GOES WHERE
NAVY WILL CUT YOU A BREAK IF YOUR SHIP MOVES OVERSEAS
WHY ARE WE SICK?
Persian Gulf war leaves legacy of illness and broken faith

Most current projects focus on concerns of OEF/OIF deployers and families

OPERATION IRAQI FREEDOM.com

Why a Longitudinal Cohort Design?

- **Allows study of causal relationships through temporal sequence**
  - **Ability to see long-term health outcomes**

The Origins of the Millennium Cohort Study

- **IOM recommended coordinated prospective cohort study of service members**
  - Capitalize on new DoD surveillance and health care data
  - Data sources that were not available at the time of the Gulf War
- **For the first time, measure the impact of deployment prospectively**

Section 743 of the FY1999 Strom Thurmond Act authorized the Secretary of Defense to establish a… ***longitudinal study*** ***to evaluate data on the health conditions of members of the Armed Forces upon their return from deployment.***

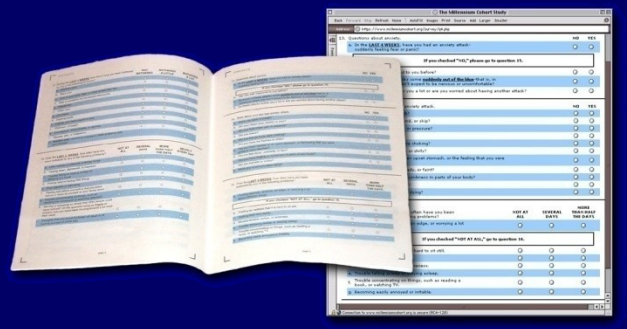
Objectives

- **To evaluate chronic diagnosed health problems, including hypertension, diabetes, and heart disease, among military members, in relationship to exposures of military concern**

- **To evaluate long-term subjective health, including chronic multi-symptom illnesses, among military members, especially in relationship to exposures of military concern**

Basic Methodology

- Survey refined based on focus group testing, pilot study, and expert review
- Questionnaire leverages standard instruments (PHQ, PCL, SF-36V, others)
- Includes measures of physical health, behavioral health, mental health
- Includes important exposure questions, and other metrics (CAM use, sleep, etc.)
- Participants respond via traditional paper, or over secure website



DMDC Reference # 00-0019 * RCS # DD-HA(AR)2106 * OMB Approval # 0720-0029
ASD/HA/TMA Protocol # CDO-06-206 * Primary IRB Protocol #

Current Status

2001: Study launched

77,047 enrolled in Panel 1 (Wave 1)

2004: Panel 1 follow-up and Panel 2 enrollment initiated

86,131 enrolled / followed-up

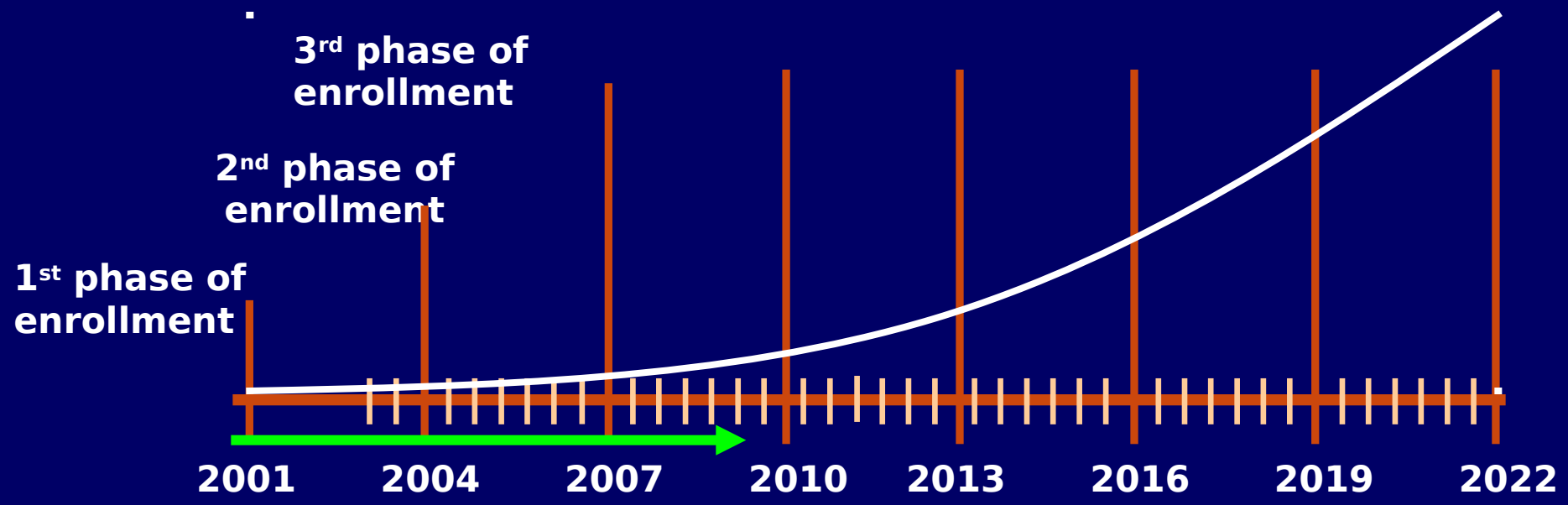
2007: Panel 1 and 2 follow-up; Panel 3 enrollment

~ 115,000 enrolled / followed-up

N > 150,000

- **~ 31% baseline response rate**
- **> 70% follow-up**
- **~ 50% deployed in support of wars in Iraq and Afghanistan**
- **~ 20% have left military service**

Millennium Cohort Follow-up



Semi-annual contact

Periodic survey of Cohort

Progress to date

Complementary Data Sources

Department of Veterans

Environmental Exposure Data

Deployment Data

Mortality Data

Pharmacologic Data

Immunization Data

Family Data e.g., DoD Birth and Infant Health Registry

Recruit Assessment Program

RAP

Civilian Inpatient and Outpatient Care

TRICARE

Military Inpatient and Outpatient Care

Survey Data

MILLENNIUM COHORT STUDY

Medical History

DoD Serum Repository

Induction

Demographic Data

Strengths and Limitations

- **Random sample of US military service members**
  - Metrics validated, good reliability, little/no response bias
- **Individuals who are ill may be less likely to participate**
  - Minimal differences in health care utilization 12 months prior to survey submission among responders and nonresponders
- **Decrements in health may have yet to emerge as current average follow-up is ~6 years**
- **Limited power to assess rare outcomes in small subgroups**
  - Long-term follow-up will increase likelihood for rare events providing increased inferential power over time

Strengths and Limitations

- **Self-reported data on subclinical conditions, symptoms, and behavioral data**
- **Ability to link to military health administrative data for objective measures of health**
- **>70% follow-up**
- **All services, components, and follow-up after military service**
- **Longitudinal design and sequence of military events allows for temporal observation of changes in health**

Summary of Published Work

>25 peer-reviewed publications and >100 scientific presentations

Foundation Manuscripts

- **Cohort representative of the invited sample and military**
  - Journal of Clinical Epidemiology. 2007 Feb;60(2):181-91
- **Baseline mental health of Cohort compares favorably to the US population**
  - Journal of Clinical Epidemiology. 2007 Feb;60(2):192-201
- **Weighted and non-weighted baseline functional health of Cohort compares favorably with civilian and other military populations**
  - BMC Public Health. 2007 Nov;7(147):340
- **Characteristics of early responders allow for targeted early follow-up**
  - BMC Medical Research Methodology. 2007 Jan;7:6

Foundation Manuscripts

- **Reliable metrics by test-retest, and internal consistency found in the cohort study data**
  - Annals of Epidemiology. 2007 Jul;17(7):525-32
- **Web-based surveys reduce costs, increase data quality and quantity; minimal risk at enrolling a non-representative group**
  - American Journal of Epidemiology. 2007 Nov;166(11):1345-54
- **Strong agreement between self-reported occupations and military occupational coding; some occupations correlated with exposures of concern**
  - Int Journal of Environmental Health Research. 2007 Aug;17(4):271-84

Foundation Manuscripts

- **Strong agreement between self-reported anthrax vaccination and electronic vaccine records**
  - American Journal Preventive Medicine, 2007 April;32(4):347-353
- **Strong agreement between self-reported smallpox vaccination and electronic vaccine records**
  - Human Vaccines. 2007 Nov/Dec;3(6):245-51
- **Strong agreement between self-report and electronic deployment data**
  - Annals of Epidemiology. 2007 Dec;17(12):976-82

Foundation Manuscripts

- **Little/no health-based response as measured by healthcare utilization prior to invitation**
  - European Journal Of Epidemiology. 2008 Feb;23(2):79-87
- **Agreement between negative self-report of medical conditions and electronic data near perfect; agreement between positive self-report of medical conditions and electronic data low but increase with length of service**
  - BMC Medical Research Methodology. 2008 June, 8:37
- **Semiannual appreciatory contact is an effective way to maintain communication with a highly mobile participant population while prompting updates of contact information**
  - Epidemiology. 2009 March; In press

PTSD Prevalence

- 2% prevalence of current PTSD symptoms in the US Military
- 1% prevalence of reported PTSD diagnosis without symptoms
- <1% reported PTSD diagnosis and current symptoms
- Lower mental and physical functioning were reported among those with PTSD symptoms and/or diagnosis

Smith TC, Wingard DL, Ryan MAK, Kritz-Silverstein D, Slymen DJ, Sallis JF, for the Millennium Cohort Study Team. PTSD prevalence, associated exposures, and functional health outcomes in a large, population-based military cohort. Public Health Reports, 2009 Jan;124:90-102.

New-onset PTSD

- **New-onset PTSD symptoms or diagnosis was identified in:**
  - 7.6% - 8.7% of those who deployed with combat
  - 1.4% - 2.1% of those who deployed without combat
  - 2.3% - 3.0% of those who did not deploy

- **After adjustment, new-onset PTSD symptoms or diagnosis was three-fold higher among those who deployed with combat exposures**
  - Army OR=3.59; 95% CI: 3.08-4.17
  - Air Force OR=3.38; 95% CI: 2.29-4.98
  - Marine Corps OR=2.78; 95% CI: 1.52-5.07
  - Navy or Coast Guard OR=2.48; 95% CI: 1.48-4.14

Smith TC, Ryan MAK, Wingard DL, Slymen DJ, Sallis JF, Kritz-Silverstein D, for the Millennium Cohort Study Team. New onset and persistent symptoms of posttraumatic stress disorder self-reported after deployment and combat exposures: prospective population-based US military cohort study. British Medical Journal. 2008 Feb;336(7640):366-71.

Persistent PTSD

- **Of those with PTSD symptoms at baseline, persistent PTSD symptoms, over the approximately 3 years between baseline and follow-up, were identified in:**
  - 43.5% - 47.9% of those who deployed with combat
  - 26.2% - 22.4% of those who deployed without combat
  - 47.6% - 45.9% of those who did not deploy

Photo source: http://www.defenselink.mil/multimedia

Prior Assault and New-onset PTSD

- **New-onset PTSD symptoms or diagnosis among combat deployers was identified in:**

  Women
  - 21.7% of women who reported prior assault
  - 10.1% of women who did not report prior assault

  Men
  - 12.4% of men who reported prior assault
  - 5.9% of men who did not report prior assault

- **In contrast to hypotheses that survival from trauma represents or confers resilience, these findings suggest vulnerability to combat stress and PTSD among survivors of prior assault**

Smith TC, Wingard DL, Ryan MAK, Kritz-Silverstein D, Slymen DJ, Sallis JF, for the Millennium Cohort Study Team. Prior assault and posttraumatic stress disorder after combat deployment. Epidemiology, 2008 May;19(3):505-12.

Baseline Functional Health and PTSD Following Combat Deployment

- **Increased risk of postdeployment PTSD for those with baseline health status <15th percentile**
  - 3-fold risk for those with mental health status < 15th percentile
  - 2-fold risk for those with physical health status < 15th percentile
  - 58% of new-onset postdeployment PTSD symptoms associated with baseline mental or physical health < 15th percentile
- **Study describes at-risk population whose health status appears to predict vulnerability to PTSD after combat deployment**
  - Interventions to prevent PTSD symptoms in this population

LeardMann CA, Smith TC, Smith B, Wells TS, Ryan MAK, for the Millennium Cohort Study Team. Baseline Self-Reported Functional Health Predicts Vulnerability to Posttraumatic Stress Disorder Following Combat Deployment: Prospective US Military Cohort Study. Br Med J, 2009: In press.

Health Events Following Smallpox Vaccination

- **Using confirmed smallpox vaccination status, no significant adverse associations between smallpox vaccination and self-reported health outcomes were found**

- **Health outcomes that were examined included:**
  - Mental and physical functioning
  - Cardiovascular diseases
  - Mental health disorders
  - Autoimmune disorders

Wells TS, LeardMann CA, Smith TC, Smith B, Jacobson IG, Reed RJ, Ryan MAK, for the Millennium Cohort Study Team. Self-reported adverse health events following smallpox vaccination in a large prospective study of US military service members. Human Vaccines. 2008 Mar/Apr;4(2):127-33.

Alcohol Problems

- Factors most strongly predictive of alcohol problems included younger age, smoking, and prior alcohol problems
- Reserve/Guard with reported combat exposures at increased odds of all three alcohol outcomes
- Results consistent between men and women
- Results consistent across service branches

Jacobson IG, Ryan MAK, Hooper TI, Smith TC, Amoroso PJ, Boyko EJ, Gackstetter GD, Wells TS, Bell NS, for the Millennium Cohort Study Team. Alcohol use and alcohol-related problems before and after military combat deployment. Journal of the American Medical Association, 2008 Aug;300(6):663-75.

Smoking

- **Deployment associated with an increase in smoking**
  - Increase predominantly due to smoking reuptake rather than smoking initiation
  - Among past smokers, deployment with combat, deploying multiple times, and deployment >9 months increased risk of smoking reuptake
  - Among baseline smokers, deployment not associated with increased amount of smoking

Smith B, Ryan MAK, Wingard DL, Patterson TL, Slymen DJ, Macera CA, for the Millennium Cohort Study Team. Cigarette smoking and military deployment: a prospective evaluation. American Journal of Preventive Medicine, 2008 Dec;35(6):539-46.

Disordered Eating and Weight Change

- **New-onset disordered eating was not associated with deployment overall**
  - Women deployed with combat exposures were slightly more likely to experience new-onset disordered eating

- **Both men and women gained weight between baseline and follow-up. Overall weight changes (gains or losses) were not significantly associated with deployment experience**
  - Youngest members had largest weight fluctuations over time
  - Cohort weight changes consistent with US national metrics

Jacobson IG, Smith TC, Smith B, Keel PK, Amoroso PJ, Wells TS, Bathalon GP, Boyko EJ, Ryan MAK for the Millennium Cohort Study Team. Disordered eating and weight changes after deployment: longitudinal assessment of a large US military cohort. American Journal of Epidemiology, 2009 Feb;169(4):415-27.

Summary of other Completed Research

>25 peer-reviewed publications and >100 scientific presentations

Other Methods-based Research

- **Early mortality experience of the Cohort examined using**
  - **NDI**
  - **AFIP**
  - **VA**
  - **SSA**
- **Open-ended text responses were analyzed using computer-based Latent Semantic Analysis**
  - **Participants with lower self-reported health were statistically more likely to respond to open-ended questions**

New-onset Depression

- **New-onset depression symptoms were identified in:**
  - 5.7% of men and 15.7% of women who deployed with combat
  - 2.3% of men and 5.1% of women who deployed without combat
  - 3.9% of men and 7.7% of women who did not deploy
- **Deployed men and women who reported combat exposures had a significantly increased risk for depression compared with nondeployed service members**
- **Deployed men and women who did not report combat exposures were at significantly lower risk for depression than nondeployed men and women**

PTSD Symptoms and Physical Activity

- 89% of participants are physically active at least 30 min/week
- At follow-up, participants with PTSD symptoms reported less physical activity than those with no symptoms
- Vigorous physical activity was associated with decreased odds of new-onset and persistent PTSD symptoms
- Light/moderate exercise at follow-up was also associated with decreased odds of new-onset PTSD symptoms
- PTSD treatment and prevention programs may benefit from a physical activity component

Newly Reported Respiratory Symptoms

- **No increase in newly reported**
  - Asthma
  - Chronic bronchitis
  - Emphysema
- **Increases in newly reported respiratory symptoms in Army and Marine Corps deployers independent of smoking behavior, demographic and military characteristics are concerning**
- **Further study needed to assess deployment-related environmental exposures that may account for these findings**

Functional Health

- **Functional health was relatively stable in the Cohort over time**
  - Small significant differences were observed in mental and physical component scores among those who deployed with combat exposures and those who deployed >9 months
  - No groups, however, had mean changes in scores near 5 points (suggested level for clinically meaningful differences)
  - Mental component scores decreased an average of 0.53 points among those who deployed with combat, and increased an average of 0.85 points among those who deployed without combat

Newly Reported Hypertension

- **6.9% reported new-onset hypertension over 3 years**
- **Deployers, in general, had lower incidence of self-reported hypertension than nondeployers**
  - 5.7% of deployers reported new-onset hypertension over 3 years
- **Deployment with reported stressful combat exposures appears to be a unique risk factor for newly reported hypertension, after adjusting for general health, demographics, and occupational and behavioral characteristics**

Interrelationship between Mental Health Disorders and Coping Behaviors

- **New-onset mental health disorder:**
  - **20-25% newly report smoking at follow-up**
  - **17-21% newly report alcohol-related problem**
- **New-onset depression:**
  - **>50% also screen positive for new-onset PTSD symptoms**
- **Rates of all new-onset mental health symptoms highest among those who had a baseline mental health disorder**
- **Rates of all new-onset mental health symptoms elevated for those who smoked or had alcohol-related problems at baseline compared to the overall Cohort**

Complementary and Alternative Medicine

- **New-onset PTSD symptoms were significantly associated with self-reported baseline use of**
  - **Herbal therapy**
  - **High-dose megavitamins**
- **Symptom and condition reporting increased among those who reported practitioner-assisted or self-administered CAM use**

Special Populations

- **Prospective analyses of mental health morbidity among:**
  - **Special forces**
  - **Individual augmentees**
  - **Professional caregivers**

Ongoing Analyses

- **General approach to comparisons include differentiating between combat deployers, non-combat deployers and non-deployers; multiple and prolonged deployments; and active duty, Reserve/National Guard**
  - Chronic multi-symptom illnesses, sleep, symptom structure, drug testing, chronic immune response disorders
  - New-onset and persistent diabetes
  - Suicidal thoughts, attempt, completion
  - Prospective analyses of mild and severe traumatic brain injury
  - Employment post military service
  - Investigation of loss to follow-up

Future Directions

- **Findings are assisting in design of intervention studies**
- **Investigation of mental and functional health of service members' families**
- **Biologic sampling to investigate markers of health outcomes**
- **Serial neurocognitive assessments in select subgroups**
- **Neuro-imaging in select subgroups**

Acknowledgments

Millennium Cohort Study Team, San Diego

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